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INTRODUCTION

The objectives of the International conference on Applied Internet and Information Technologies are aligned with the goal of regional economic development. The conference focus is to facilitate the implementation of Internet and Information Technologies in all areas of human activities. The conference provides a forum for discussion and exchange of experiences between people from government, state agencies, universities, research institutions, and practitioners from industry. Information technologies change during time and this year AIIT conference addressed the diversity of ICT application areas and relevant research topics such as:

- Information systems
- Software engineering and applications
- Data science and big data technologies
- Business intelligence and IT support to decision-making
- Communications and computer networks
- Data and system security
- Distributed systems
- Internet of Things
- Embedded systems
- Software quality
- Software maintenance
- Computer graphics
- IT management
- E-commerce
- E-Government
- E-Education
- Internet marketing
- ICT practice and experience

Information technologies enable collaboration across the globe. This year the conference was successfully co-organized by 5 institutions from 4 countries - Serbia, North Macedonia, Russia, and Bulgaria. It has been managed in collaboration with 3 co-chairmen from Serbia, North Macedonia, and Russia.

International Conference on Applied Internet and Information Technologies (AIIT) is an annual conference that was held since 2012, based on successful results of the International Conference on Information and Communication Technologies for Small and Medium Enterprises in 2011. This year, AIIT2020 was held on October 16, 2020, in Zrenjanin, Serbia.

Due to a COVID-19 pandemics, the conference is held in virtual form, with online presentations with Google Meet, and streaming video and poster presentations available at the web site of the conference (http://www.tfzr.uns.ac.rs/aiit/). There were 54 accepted papers with 125 authors from 21 countries (Serbia, North Macedonia, Montenegro, Bosnia and Herzegovina, Croatia, Slovenia, Romania, Hungary, Bulgaria, Slovakia, Russia, Sweden, United Kingdom, USA, Canada, India, Sri Lanka, Japan, China, Egypt, and Iraq). The papers are presented online, or in the video stream and poster sessions. Within the video presentation session, there is a presentation of IT company ACS – Advanced Cyber Security, Belgrade, Serbia.

The AIIT 2020 organizing committee would like to thank the authors of the papers for their contribution. All submitted papers were peer-reviewed by the members of the AIIT2020 program committee. Each submitted paper was assigned to at least two reviewers from different countries and the paper analysis was conducted as a double-blind review.

Special gratitude is addressed to many reviewers from co-organizing institutions that made a great impact on the quality of papers. The AIIT organizing committee especially appreciates the IT company's efforts in supporting the conference by its participation.

Information technologies are integrated with every human activity. IT application enhancements are encouraged by university research, business organizations, public institutions, and the IT industry. The AIIT organizing committee welcomes future presentations of work in this field at the next AIIT conference, hoping that all of us will meet again in the real conference event.

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APPENDIX

Blockchain Technology and its Application in the Finance and Economics

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Abstract - As a new technology, blockchain can be used to analyze and process the data through the effective integration of financial resources. New financial formats or service models are produced to upgrade the financial system and promote the efficiency and quality of financial operations and service from three layers: data, rules and application, based on customers' needs. The blockchain technology can help the financial industry to automatically and accurately identify customer credit conditions, restructure the financial market credit system, and improve the efficiency of cross-border payments. It also posed a challenge for the financial industries' development. In this paper, we systematically analyzed the blockchain technology and its application in the financial and economic domains. With the introduction of blockchain technology in banking operations, the possibility for banks to grant non-performing loans is reduced, thus improving their effectiveness. Using the possibilities offered by the new technology will not allow a situation in which the bank should go bankrupt. Among the other advantages offered by this technology is the great acceleration of the international transfer of funds, which can be done in a few minutes, and in traditional banking, it takes several days in developed economies or even more so in developing countries.

I. INTRODUCTION

Blockchain technology was introduced in 2008 with Nakamoto's white paper "Bitcoin: A Peer-to-Peer Electronic Cash System" [1]. The first blockchain is Bitcoin. Beyond their use in the economic domain, Bitcoin and blockchain technology as articulated by Nakamoto, solve an important computer science problem that had been a barrier to having a functional digital monetary system for years: the double-spending problem. The double-spending problem is that money should only be spent once. The first Bitcoin transactions occurred in January 2009.

Corporate, industrial, and government interest in blockchain technologies is high because applications extend well beyond the domain of cryptocurrencies. There are four main application classes for blockchain technology:

(1) monetary assets (currency, payments, remittance, finance, securities, and financial instruments),

(2) property (land, real estate, and auto title registries),

(3) contracts (business agreements, licensing, registration, wills and trusts, partnership agreements, and IP registration), and

(4) identity credentials (passport, visa, driver's license, and birth registries).

Since 2015, a large number of international financial organizations plan to further develop the blockchain system. In 2014, a consortium called R3 was established, to start research and development of blockchain technology. In March 2017, this group counted about 75 companies to reach 200 in March 2018, including Bank of America, Merrill Lynch, UniCredit Group and many other real estate companies with the goal of better education, law and technology development in blockchain technology [14]. The formation of such a strong corporation with a lot of research and implementation of blockchain technology, especially in the financial sector, tells us that it is a new era in the development of banking before us. In our country, individuals have expressed concern that the conditions for granting credit facilities are often too strict, or that they need to secure a mortgage, or that they do not have access to credit at all. Interest rates are steadily different from the average European Union and significantly higher risks are being borne, which leads to unstable economies, but also high operating costs at which new technologies can be applied can act. Applying new technology, the banking sector would create conditions for a significant increase in operating, reducing exposures, a large number of risks that would result in innovation in lending activities, even lower interest rates on placements.

The rest of the paper is organized as follows. Distributed ledger technology is explained in Section II, while SWOT analysis of using the blockchain technology in finance and economics is depicted in Section III. The subsequent section is devoted to the application of blockchain technology in financial and economic domains and the new challenges of the application of blockchain technology are described in Section V. The last Section gives concluding remarks.

II. DISTRIBUTED LEDGER TECHNOLOGY

Blockchain (distributed ledger technology) is a network software protocol that enables the secure transfer of money, assets, and information via the Internet,

without a third-party organization as an intermediary [2]. It can safely store transactions such as digital cryptocurrencies or data/information about debt, copyrights, equity, and digital assets. The stored information cannot be easily forged and tampered because it requires individual approval of all distributed nodes. This significantly reduces the cost of trusting and accounting that commonly exist in non-digital economies and other social activities. Blockchain has four components:

(1) hash, which uses one-way mathematical functions to assign unique indexes;

(2) a digital signature, which is implemented as a public cryptographic key;

(3) peer-to-peer (P2P) network, which serves as a routing structure for nodes to use the distributed hash; and

(4) consensus mechanism, which is a set of digital procedures designed to ensure the accuracy and consistency of the stored information across the participating nodes.

The blockchain data structure is depicted in Fig.1 [3].

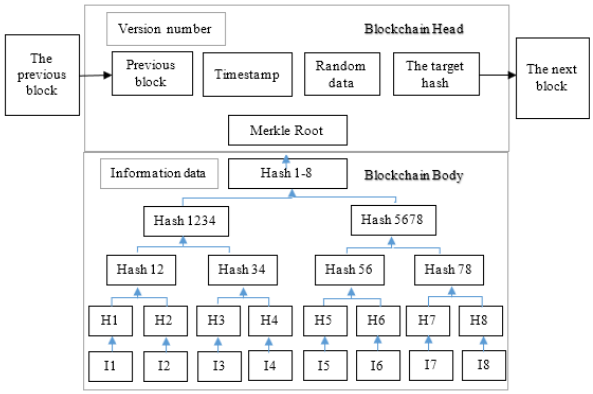

Figure 1. The blockchain data structure.

In the Blockchain Body, the bottom is a part of Merkle Hash Tree which can be either a binary tree or a multitree in the data structure. Specifically, data or information is recorded as the hash value stored in Blockchain Body, and the generated Merkle root through Merkle tree's hash process will be recorded in Blockchain Head.

The blockchain technological platform is gradually shaping up into three directions: (1) underlying infrastructure which includes facilities for mining and manufacturing of specialized computer hardware to perform blockchain-related tasks; (2) middle layer between the blockchain platform and client application services, including smart contracts, a blockchain platform, financial software, and other services; and (3) hotspot distributed applications in various industries, including finance (e.g., cross-border payments, liquidation, financial services, and asset digitization), cybersecurity (e.g., identity protection, data authenticity protection, and critical infrastructure protection), and supply chain management (e.g., logistics tracking and digital works tracking).

This distributed general ledger is replicated to thousands of computer nodes around the world and is publicly available. Despite all its openness, it is also confidential and reliable. This is achieved through a mathematical puzzle and computer power embedded in its "consensus mechanism" - the process in which the nodes agree on how to update the blockchain with each transaction of moving the value from one person to another. Users use public and private keys to digitally sign and make transactions in the system in a secure way. Blockchain users can solve puzzles using cryptographic hashing methods hoping to be rewarded with a fixed amount of cryptocurrency [4].

Blockchain systems seem complex. However, they can be easily understood by examining each technology component individually. At a high level, blockchains utilize well-known computer science mechanisms (linked lists, distributed networking) as well as cryptographic primitives (hashing, digital signatures, public/private keys) mixed with financial concepts (such as ledgers) [5].

A ledger is a collection of transactions. Ledgers are often stored digitally in large databases owned and operated solely by centralized "trusted" third parties however we must trust the third party that the data is backed up, transactions are validated and complete, and the history is not altered. A ledger implemented using a blockchain can mitigate these issues through the use of a distributed consensus method. One of the aspects is that the blockchain ledger will be copied and distributed amongst every node within the system. When new transactions are submitted to a node, the rest of the network is alerted that a new transaction has arrived and at this point, this is a pending transaction. Eventually, one of the nodes will include this new transaction within a block and complete the system's required consensus method. This new block will be distributed across the network and all ledgers will be updated to include the new transaction. When new users join the system, they receive a full copy of the blockchain, making loss or destruction of the ledger difficult. Each transaction that is submitted to the network passes through several steps to be included and published in a block of the blockchain:

A transaction is a record of a transfer of assets (digital currency, units of inventory, etc.) between involved parties. For each input transaction A, an output hash value #A is created using a cryptographic function.

Hashing is a method of calculating a relatively unique fixed-size output for an input of nearly any size (e.g., a file, some text, or an image). Even the smallest change of input will result in a completely different output digest. Hash algorithms are designed to be one-way: it is computationally infeasible to find any input that maps to any pre-specified output. If a particular output is desired, many inputs must be tried by passing them through the hash function until input is found that gives the desired result. Moreover, hash algorithms are designed to be collision resistant: it is computationally infeasible to find two or more inputs that produce the same output. A

commonly used hashing algorithm in many blockchain technologies is the Secure Hash Algorithm (SHA) with an output size of 256 bits (SHA-256).

Each block in a blockchain contains multiple transactions, transactions are grouped in sets. Hash values are further combined in a system called a Merkle tree [15].

Merkle tree is a data structure where the data is hashed and combined until there is a singular root hash that represents the entire structure. The root is an efficient mechanism used to sum up the transactions in a block and verify the presence of a transaction within a block. This structure ensures that the data sent in a distributed network is valid since any alteration to the underlying data would be detected and can be discarded. The result of all the hashing then goes into the block's header, and it is combined with the hash of the previous block's header and a timestamp. This combination becomes a part of the cryptographic puzzle. The solution for the puzzle is to find a nonce value.

The nonce value is a number manipulated by the mining node to solve the hash puzzle and with this, it gives them the right to publish the block. After creation, each block is hashed thereby creating a digest that represents the block. The change of even a single bit in the block would completely change the hash value. The block's hash digest is used to help protect the block from change since all nodes will have a copy of the block's hash and can then check to make sure that the block has not been changed. An additional feature of blockchain systems is that they can run so-called smart contracts [7], which is an auto executable code that fires off once certain conditions are met. A smart contract is computer protocol or collection of code and data which runs automatically under defined criteria when deployed on the blockchain. The contract executes the appropriate method with the user-provided data to perform a service. The code, being on the blockchain, is immutable and therefore can be used (among other purposes) as a trusted third party for financial transactions that are more complex than simply sending funds between accounts. A smart contract can perform calculations, store information, and automatically send funds to other accounts. It doesn't necessarily even have to perform a financial function.

III. SWOT ANALYSIS

The advantages and disadvantages of using blockchain technology in financial operations presented through SWOT analysis:

Strength:

1) Operational efficiency; The exchange of information with an electronic system can contribute to financial efficiency;

2) Secure encryption; Registry distribution technology provides secure encryption and capabilities to protect against unauthorized access important data;

3) Lower costs; Registry of distributed data for transactions shows the cost of storage in order with the existing method;

Weakness:

1) Given that there is no regulation in our country, it is difficult to adopt the current service;

2) Lack of experts; Good immaturity and short blockchain history, there are only several experts;

3) Possibility of collisions; In the process of blocking, there is a possibility of a collision that did not exist in the existing methods. (Problems with compatibility that are not present in traditional, well-distributed servers, one of the most widely used and stable technologies, blockchain usage may occur).

Opportunity:

1) Transparency transaction that feeds the blockchain enables gaining credentials publicity;

2) Potential partnership; learning from a mature partner that uses blockchain for financial gain;

3) Advanced financial system; integrated ordinary data can improve financial performance in the future.

Threat:

1) Problems of culture and beliefs; Blockchain application of sensitive data can provoke social antagonism. (It's hard for us laity users to simply think about blockchain. However, it does not help to reason only about an abstract concept. if users do not understand the dangers of security and stability technology).

2) Obstacles caused by excessive regulation; Excessive regulation can limit and hinder the realization of blockchain values.

3) Requires motivation; In order to try to use unknown technologies, it is necessary to motivate the software industry to get involved.

IV. APPLICATION OF BLOCKCHAIN TECHNOLOGY IN FINANCE AND ECONOMICS

There are three main theories related to blockchain finance and economics. First, Illing and Peitz [8] proposed a digital economy theory that promotes the convergence of computer and communications technologies to digitize all assets and then register and transfer notarized digital assets on the blockchain. Ultimately, it will realize the complete digitization of goods and services from manufacturing, sales, and supply chain. Second, free currency studied by Chen [9] states that the dialectical relationship between money and freedom from Marx's economic philosophy perspective. Specifically, the currency should not be issued by the central bank of a government but should be completely decentralized and nonstate owned. All kinds of digital currencies can be exchanged freely in the blockchain economy. Additionally, the digital currency repeats the emergence, elimination, and evolution of the competitive process at an extremely rapid rate. Last, Marcel, Oran, and Otgon adopted information asymmetry theory to examine the trust problem as the different information held by both parties [10]. The theory provides methodological guidance for blockchain finance and economics because blockchain can realize the optimal allocation of resources through the form of digital

rewards for mining to establish decentralized credit for universal participation.

A. Cryptocurrency and its trading platforms

Bitcoin is the first decentralized cryptocurrency and a worldwide payment system without a central bank. Transactions take place between users directly over the P2P network without an intermediary. These transactions are verified by network nodes through the use of cryptography and recorded in a public distributed ledger called a blockchain. There are many other types of cryptocurrencies, such as *Ethereum* (it can be used by programmers to pay for transaction costs and services in the Ethereum network), Bitcoin Cash (it is generated after bitcoin's hard fork), *Ripple* (it is a global clearinghouse for other currencies or other value entities such as U.S. dollar, Euro, Pound sterling, bitcoin, airline miles, and commodities), *Litecoin* (it is an early replacement of bitcoin designed to allow ordinary people to mine as well), and *Dash* (it can be paid instantly via a unique, two-tiered network). Therefore, the cryptocurrency has attracted more and more countries' attentions and become an indispensable application of blockchain finance and economics.

1) Comparative analysis of national currency and cryptocurrencies

The differences between the national currency and the cryptocurrency are not so significant and include:

- the absence of an issuer – the cryptocurrency is created by "mining", similar to gold or minerals, with the help of significant computer capacities;
- lack of physical form – if modern physical money (paper banknotes or coins) is provided with several degrees of protection, the cryptocurrencies and money in the banking system, at accounts and cards, are protected by complex information technologies, but banking information security and algorithms for creating and transferring cryptocurrency are fundamentally different;
- the absence of a regulator – cryptocurrencies and transactions on them are not controlled by government bodies or any personified and institutional subjects.

Between national and cryptocurrencies there are a lot of common features:

- they serve as a value meter; both currencies' types are stored in electronic records on computing capacities (usually, huge servers of financial institutions);
- they operate on a competitive basis in the market of currencies (national currencies and cryptocurrencies are exchanged at a floating rate).

Since March 1968, when the US stopped exchanging private dollars for gold at a fixed price ($ 35 per troy ounce), and after, August 1971, when this ban was "temporarily" set for the exchange of the dollar for gold also for national central banks, the trust of people to paper money is gradually reducing.

Cryptocurrencies have several advantages over national currencies:

- cryptocurrencies do not depend on changes in the political situation, their course is not subject to geopolitical risks;
- transactions in cryptocurrencies are controlled by a multitude (hundreds of thousands) of computers, but are not subject to the control of any authorities or persons; they are completely anonymous for people and are characterized by a high degree of confidentiality.

Accordingly, such transactions are nor a subject of the international agreements of competent (tax) authorities on automatic information exchange (Multilateral Competent Authority Agreement, MCAA) or on requesting information (the Convention on Mutual Administrative Assistance in Tax Matters), as well as of the US Foreign Account Tax Compliance Act (FATCA), which obliges all financial and non-financial, insurance and similar institutions to provide the US Internal Revenue Service with information on financial accounts and transactions of US tax residents [6].

B. Cross-border payment

Cross-border payments generally refer to the transnational and transregional transfer of funds between two or more countries or territories through international trade, international investment, and other international claims and debts using certain settlement instruments and payment systems. The traditional cross-border payment is based on the banking system which has such characteristics as time-consuming, high cost, more funds occupied, and low security. However, all these bottlenecks can be effectively overcome by applying blockchain to reconstruct the credit system and expand the payment boundary. Researchers pointed out that applying blockchain technology to the cross-border payment has a high potential effect. Holotiuk, Pisani, and Moormann [11] stated that the blockchain technology will improve the payment system by providing a solid structure for cross-border transactions and removing expensive intermediary costs and gradually weaken or alter the business model of the existing payment industries. R3 has been working with 22 of its member banks to build a real-time, cross-border payments solution on Corda that is the consortium's "blockchain-inspired" distributed ledger [12].

C. Digital asset register and management

Related to digital currencies and money transfer, one of the biggest blockchain applications is digital asset register and management. The blockchain technology can record, transfer, and verify asset ownership (e.g., home, auto, stocks, bonds, mortgages, and insurance) and preserve the integrity and authenticity of sensitive documents or records (e.g., passports, visas, driver's licenses, birth and death certificates, voter registration,

contracts, wills, patents, and medical records). An exemplary implementation of a digital asset register for identity services is the State of Illinois's blockchain-based birth register [13]. The blockchain patent has been filed by different companies such as the giant Amazon.com and the start-up Coinbase. Additionally, some companies are filing for blockchain-related patents to protect their digital asset.

Regulatory mechanisms are based on the legitimacy of rules that meet basic values (values' coherence and regulatory efficiency), and on the transparency of their implementation, which can be interpreted as the effectiveness of rules-driven normative regulation.

The development of ICT (information and communication technologies) permits to control if the process is carried out correctly and to assure the total coverage of rules' application, providing the adequate normative (i.e. legal) regulation.

D. The COVID-19 coronavirus versus the Red Cross: better solutions via blockchain and artificial intelligence

Beijing has ordered all public donations for the Wuhan crisis to be transmitted to five government-backed charity organizations. This is a throwback to pre-2016 China, before the Charity Law of China was introduced to enable the establishment of private charities. The Charity Law was intended to develop the charity field and protect the interests of relevant stakeholders. Although all charities in China are required to have in place sound internal governance structures, the charging order implicitly assumes that the five government-backed charities are fit for purpose and better able to manage the current crisis. That assumption may be at odds with historical and more recent evidence suggesting organizations responsible for responding to crises appear to struggle to manage their core responsibilities. And if Beijing's implicit assumption is wrong then the centralizing effect produced by charging merely serves to compound the problem.

In this instance, and not for the first time, the Red Cross in China is in the crosshairs of public anger. 'One of the lessons learned was that emergency response must be better developed at the local level'. This is what the Red Cross said in 2017 on the 10th anniversary of the deadly Wenchuan earthquake in Sichuan province in western China. Billions of dollars had been donated following the Sichuan earthquake but had been 'mishandled'. What has been learned? The public in China has again been angered by the mishandling of donations, and this impacts on the willingness to donate, which retards the objective of addressing a problem.

Blockchain and AI are now in frequent use by global tech companies and represent tools that can be used to better manage crises. A private blockchain network would enable the recording and tracking of anything that is donated, from donation dollars to N95 masks. It also creates clear points at which it is possible to hold a person or organization to account, from the loading of donations for delivery through to its final end-use. Importantly, the blockchain can also be given public visibility, providing transparency to all stakeholders - donors and recipients, as well as public oversight bodies. Anyone could track the progress and use of their donation.

V. THE CHALLENGES OF BLOCKCHAIN IN FINANCE AND ECONOMICS

It usually takes 10 min to add a new block to the blockchain. Thus, each block's capacity is only 1 MB and the online capacity allows only eight transactions per second. The blockchain has a huge gap with the current third-party payment named Alipay, which supports thousands of transactions per second. Blockchain establishes the credit guarantee of the trusted intermediary through a program algorithm. However, its information is irreversible, which makes the system more difficult to recover if the private key or password is lost or leaked, resulting in irreparable loss of customer assets. Although the blockchain has the clear technical logic and is theoretically difficult to be violently cracked, the possibility of a data breach still exists through the hostage of a large number of zombies or the operation mode of a trade unions cluster. Therefore, technical risks such as hackers must be addressed with blockchain development.

A. Problems of financial regulation

Financial regulation is a powerful guarantee for Internet financial information security. However, the emergence of blockchain finance and economics has brought decentralization, which greatly increases the relevance and effectiveness of financial regulation. At present, people have a relatively low understanding and acceptance of the blockchain and it is hard to identify real and effective blockchain financial products. It is difficult for regulators to lock in many anonymous accounts of clients and understand the whereabouts of funds. Additionally, the absence of a central system has facilitated convenience for the money laundering, fraud, and tax evasion as well as increased the difficulty of supervision and management.

B. Complexity in global collaboration

The layout of blockchain finance and economics in the world is difficult due to the great cultural diversities and liberal democracy. Using virtual currency as an equivalent to achieving real-time global liquidation is a challenge for the central bank's legal tender and the right of payment. The legal tender is endorsed by national credit.

However, the virtual currency credit is the mathematical algorithm that is difficult to reflect any single country's financial will. For example, only a few countries such as Japan, Germany, and the United States of America recognize the legal status of bitcoin. Most countries cannot accept Bitcoin's monetary attributes, especially in China. Therefore, the further application and development of blockchain technology in the global financial and economic field need to balance the interests of all countries to reach a consensus.

VI. CONCLUSIONS

In this paper, a system for electronic transactions without relying on trust is proposed. The traditional system is incomplete because there isn't a way to prevent double-spending. To solve this, there is a peer-to-peer network using proof-of-work to record a public history of transactions that quickly becomes computationally impractical for an attacker to change if honest nodes control a majority of CPU power. The network is robust in its unstructured simplicity. Nodes work all at once with little coordination. They do not need to be identified, since messages are not routed to any particular place and only need to be delivered on a best-effort basis. Nodes can leave and rejoin the network at will, accepting the proof-of-work chain as proof of what happened while they were gone. They vote with their CPU power, expressing their acceptance of valid blocks by working on extending them and rejecting invalid blocks by refusing to work on them. Any needed rules and incentives can be enforced with this consensus mechanism.

Blockchains could revolutionize the underlying technology of the payment system and credit information systems in banks, thus upgrading and transforming them. Blockchain applications also promote the formation of "multi-center, weakly intermediated" scenarios, which will enhance the efficiency of the banking industry.

It is worth noting that the problems of regulation, efficiency, and security have always sparked extensive debate in the process of each new financial innovation. History is not stopped by current obstacles, as the technical, regulatory, and other problems of blockchain technology will ultimately be resolved. Hence, the prospect of integrating blockchain technology into the banking industry will most likely occur soon.

REFERENCES

[1] S. Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System, 2008. https://bitcoin.org/bitcoin.pdf (Website accessed 07.09.2020).

[2] Swan, M. Blockchain: Blueprint for a new economy, 2015. Retrieved from https://www.goodreads.com/-work/best_book/44338116-blockchain-blueprint-for-a-new-economy (Website accessed 07/09/2020).

[3] Li Zhang, Yongping Xie, Yang Zheng, Wei Xue, Xianrong Zheng, Xiaobo Xu, The challenges and countermeasures of blockchain in finance and economics, John Wiley & Sons, Ltd 2020

[4] Iansiti, Marco, and Karim R. Lakhani. "The truth about blockchain." Harvard Business Review 95.1, Jan (2017). https://hbr.org/2017/01/thetruth-about-blockchain, (Website accessed 07.09.2020).

[5] https://nvlpubs.nist.gov/nistpubs/ir/2018/NIST.IR.8202.pdf, (Website accessed 07.09.2020).

[6] N. N. Pokrovskaia, Tax, Financial and Social Regulatory Mechanisms within the Knowledge-Driven Economy. Blockchain Algorithms and Fog Computing for the Efficient Regulation, 2017

[7] Szabo, Nick. "The idea of smart contracts". Nick Szabo's Papers and Concise Tutorials, 1997.

[8] Illing G., & Peitz, M., Understanding the digital economy: Facts and theory introduction., *CESifo Economic Studies*, 2015, *51*(2/3), 187–188. https://doi.org/10.1093/cesifo/51.2-3.187

[9] Chen, F. , A probe into the dialectical relationship between money and freedom—From the perspective of Marxist Economic Philosophy. *Nanjing Social Science*, 2017, *8*, 75–81.

[10] Marcel, B., Oran, T., & Otgon, C., Information asymmetry theory in corporate governance systems. *Annals of the University of Oradea, Economic Science Series*, 2010, *19*(2), 516–522.

[11] Holotiuk, F., Pisani, F., & Moormann, J.. The impact of blockchain technology on business models in the payments industry. Wirtschaftsinformatik 2017 Proceedings. Retrieved from https://aisel.aisnet.org/wi2017-/track09/paper/6 (Website accessed 07.09.2020).

[12] Crosman, P. *R3 to take on Ripple with cross-border payments blockchain*. American Banker; New York, N.Y., 2017. Retrieved from https://search-proquest-com.ucd.idm.oclc.org/docview/1957965453/ citation/F4C0367615-95447CPQ/1 (Website accessed 07.09.2020).

[13] Evernym.com. State of Illinois Partners with Evernym to Launch Birth Registration Pilot, 2017. Retrieved from http:// globenewswire.com/news-release/2017/08/31/1106400/0/en/Stateof-Illinois-Partners-with-Evernym-to-Launch-Birth-RegistrationPilot.html (Website accessed 07.09.2020)

[14] Dragana Tadić Živković, blockchain technology: opportunity or a threat to the future development of banking, Proceedings of Ekonbiz, 2018

[15] Julija Basheska, Vladimir Trajkovik, Blockchain based Transformation in government: review of case studies, XIV International Conference ETAI 2018, Struga, Macedonia.

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